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FINAL TECHNICAL REPORT

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Ginga Studies of Black Hole Candidates: Multiwavelength Studies Using Temporal Lags and Coherence Function Analysis

and

Ginga Archival Studies of QPOs in LMXB Z-Sources

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A Modified Beat Frequency Modulated Accretion Model I. Spin Periods and Magnetic Moments of Z-Sources Inferred from Horizontal Branch QPO

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ABSTRACT

We present a modified beat-frequency modulated accretion model appropriate to a description of the horizontal branch oscillations of Z-type low-mass x-ray binaries. This model incorporates several new physical elements: (i) magnetic screening by the accretion disk and neutron star, (ii) radiation pressure dominance in the inner disk, and (iii) stellar rotation effects. Fitted to observational data, the model constrains the surface magnetic field in a typical LMXB Z source to be less than 10^9 G and the stellar spin frequency to be greater than 400 Hz. The predicted high stellar spin frequency falls in a range where observational upper limits on pulsation are not a constraint. The derived magnetic field and spin frequency range are compatible with the fastest radio pulsars.

Subject headings: Z Sources, LMXB, QPO, accretion torques

Introduction The purpose of the research performed under N00014-93-1-2001 was to carryout analysis of x-ray temporal observations of several bright galactic x-ray binary systems containing neutron stars that are suspected to have weak magnetic fields and rapid spin periods and to study the X-ray timing signals from binaries suspected to contain black holes. Cygnus X-1 is such a source. The observations and analysis were done in a collaborative mode with the Naval Research Laboratory, Washington, D.C. and the Institute of Space and Astronautical Science (ISAS) of Japan. The observations were performed with the orbiting Japanese x-ray observatory *Ginga*. Analysis was done on computers at Stanford University, NRL and ISAS.

The following paper was published with collaborators during the performance period:

Vaughan, B.A., et al. " Searches for millisecond pulsations in low-mass X-ray binaries. II." Ap.J. 435, 362, 1 Nov. 1994

A preprint of a paper entitled "A modified beat frequency modulated accretion model I. Spin periods and magnetic moments of Z-sources inferred from horizontal branch QPO", is about to be submitted for publication.

Inventions and Patents: There were no inventions or patents that resulted from work performed under this contract.